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‘BACK TO THE CAVE’- DESIGNING SYMBIOTICALLY OPERATING HABITATION MODULES IN  
MARTIAN CAVES

**Abstract**

In recent decades, the research in the field of exploration of human habitation in space, particularly on Mars, has intensified due to its proximity, favourable gravitational conditions, and potential water sources. Designing a sustainable habitat on Mars poses challenges, notably protection from the Martian atmosphere and addressing psychological issues associated with living in a different environment. ‘Back to the Cave’ habitat is a dual-module symbiotic structure system which aims to be expanded on a modular basis within a man-made cave system in the eastern Noctis Labyrinthus. The aim of the project is establishing a human base on Mars and researching the plausibility of human colonisation of the planet with the habitat specifically focusing on providing facilities for research of food growth, search, and validation of water sources. The initial habitat base will consist of two modules containing the greenhouse and the living/research spaces, conceptually inspired by the division of cells. The modules will operate on a symbiotic relationship exchanging the CO and O between the living/research and greenhouse modules. The infrastructure of the modules can be expanded on a modular basis creating a system of interdependent habitats. The modules are organised to provide the inhabitants with workspaces, communal living spaces, private living areas and a greenhouse in order to improve the psychological needs of the inhabitants. The eastern part of Noctis Labyrinthus has been chosen as a suitable location due to proximity to a relict glacier in order to conduct water research. Another benefit of this location is the valleys (cavus) that spread across the area which would provide a suitable landing site. The cave also provides protection from micrometeoroids and solar radiation. The modules will be thermally insulated from the inside and some internal furnishings will be grown out of mycelium. These methods aim to reduce the amount of transported materials. The project is divided into two missions, aiming to finally bring a selected group of six humans on Mars and eventually preparing the ground for a future colonisation of the planet. The modular structure system and the cave inhabitation system aim to offer sustainable design principles for incremental expansion of human colonisation of Mars.